Datation et Caractérisation des Milieux Pléistocènes
Actes des Symposiums 11 et 17 de la 11ème R.S.T., Clermont-Ferrand, 1986
Cahiers du Quaternaire N° 16
1991, p. 337 - 347, 1 fig., 1 tab.

MIDDLE PLEISTOCENE SMALL MAMMALS FROM ATAPUERCA (BURGOS, SPAIN)

Enrique GIL[1]
Carmen SESÉ[2]

Les micromammifères du Pléistocène moyen d'Atapuerca (Burgos, Espagne)

Abstract

The Sierra of Atapuerca, near Burgos (Spain), is a karstic complex where anteneandertalian human remains were found in the filling called "Sima de los Huesos". We have found some faunas of small mammals in this filling and in other fillings located in the area called "Trinchera of Atapuerca" : "Gran Dolina" and "Tres Simas complex". All these faunas of small mammals, the preliminary study of which we make here, can be situated in the Middle Pleistocene. Among them, we recognize at least two different faunal associations mainly belonging to the Arvicolidae : I) One faunal group is that of the lower stratigraphic levels of the "Gran Dolina" filling and is characterised by the following species : *Pitymys gregaloides-arvalidens*, *Microtus brecciensis*, *Pliomys episcopalis*, *Mimomys savini* and *Arvicola chalinei*. It can be placed in the phases Nagyharsanyhegy/Templomhegy of the Biharian. II) The other faunal group is that of the upper stratigraphic level of the "Gran Dolina" filling and those of the "Tres Simas complex" and is characterised by the following species : *Pitymys subterraneus*, *Microtus arvalis-agrestis*, *Microtus brecciensis*, *Pliomys lenki* and *Arvicola* sp. of large size. It may be dated to the last phases of the Biharian (Versteszzöllös/Uppony) or lower Olden-burgian. Other species of rodents recovered in Atapuerca are *Allocricetus bursae*, *Eliomys quercinus* and *Apodemus* sp., present in almost all of the localities, *Marmota marmota* in some levels of faunal groups I and II, and *Hystrix* cf. *vinogradovi* in faunal group II. In Atapuerca faunas of the beginning of the Middle Pleistocene (phases Nagyharsanyhegy/Templomhegy of the Biharian) are found for the first time in Spain as well as a faunal sequence with at least two different faunal associations which covers a period between those phases of the Biharian until the last phases of the Biharian or the lower Oldenburgian.

Key words

Small mammals, Biostratigraphy, Middle Pleistocene, Spain, Atapuerca, Karstic localities.

Résumé

La Serre d'Atapuerca, près de Burgos (Espagne), est un complexe karstique où furent trouvés des restes humains anténeandertaliens dans le remplissage dénommé "Sima de los Huesos". Nous y avons aussi trouvé quelques petits mammifères ainsi que dans des remplissages placés dans la dénommée "Trinchera d'Atapuerca" : "Gran Dolina" et "Complexe Tres Simas". Toute cette faune de petits mammifères, desquels nous faisons ici une étude préliminaire, correspond au Pléistocène Moyen. Entre eux nous reconnaissons, au moins, deux différentes associations faunistiques principalement basées sur les Arvicolidae : I) Un groupe faunistique est celui des niveaux inférieurs de la "Gran

(1) Departamento de Paleontología, Sección Geológicas, Facultad de Ciencias, Ciudad Universitaria, 50009 Zaragoza, España.
(2) Museo Nacional de Ciencias Naturales C.S.I.C., Paleontología, J. Gutiérrez Abascal 2, 28006 Madrid, España.

Dolina" et il est caractérisé par les espèces suivantes : *Pitymys gregaloides-arvalidens*, *Microtus brecciensis*, *Pliomys episcopalis*, *Mimomys savini* et *Arvicola chalinei*. Ce groupe peut être placé dans les phases Nagyharsanyhegy/Templomhegy du Biharien. II) L'autre groupe faunistique est celui du niveau stratigraphique supérieur de la "Gran Dolina" et de ceux du "Complexe Tres Simas" et il est caractérisé par les espèces suivantes : *Pitymys subterraneus*, *Microtus arvalisagrestis*, *Microtus brecciensis*, *Pliomys lenki* et *Arvicola* sp. de grande taille. Cette association peut être datée entre les dernières phases du Biharien (Versteszöllös/Uppony) et l'Oldengurgien inférieur. A Atapuerca nous avons aussi trouvé les espèces de rongeurs suivantes : *Allocricetus bursae*, *Eliomys quercinus* et *Apodemus* sp. qui sont dans presque tous les gisements, *Marmota marmota* qui ne se trouve que dans quelques niveaux des groupes faunistiques I et II, et *Hystrix* cf. *vinogradovi* qui ne se trouve que dans quelques niveaux du groupe faunistique II. A Atapuerca, on a trouvé pour la première fois en Espagne des faunes de petits mammifères du commencement du Pléistocène Moyen (phases Nagyharsanyhegy/Templomhegy du Biharien) et aussi une succession faunistique comportant, au moins, deux différentes associations faunistiques dont l'âge est compris entre ces phases du Biharien et les dernières phases du Biharien (Versteszöllös/Uppony) ou l'Oldenburgien inférieur.

Mots clés
Petits mammifères, Biostratigraphie, Pléistocène Moyen, Espagne, Atapuerca, Gisements karstiques.

INTRODUCTION

The Sierra of Atapuerca, near Burgos, is located in the north oriental edge of the Duero Basin. It is mainly formed by Cretaceous limestones. Some Neogene materials like clays and marls are in discordance with the principal structure of the Sierra.

In the karstic complex of Atapuerca, anteneandertalian human remains were found (Aguirre *et al.*, 1976 ; Aguirre & de Lumley, 1977) in the filling called "Sima de los Huesos". After the excavations directed by Dr. T. Torres in 1976, these findings led to a wide investigation project directed by Dr. E. Aguirre and financed by the CAICYT since 1980[3]. In 1978 Torres published a paper on the bears of the "Sima de los Huesos". Afterwards, a geomorphological study of the Sierra of Atapuerca was made by Zazo *et al.* (1983).

From the several fillings of the karstic complex of Atapuerca, we have studied the fossil remains of the small mammals of the "Sima de los Huesos" (SH) and of the following fillings of the "Trinchera of Atapuerca" : "Gran Dolina" (TD), and the "Tres Simas complex" that is composed of the three following sections : "North entrance of Tres Simas" (TN), "Galería or Sala Intermedia" (TG), whose topmost part extends the vertical conduit TN almost horizontally, and, finally, the "Cueva de los Zarpazos" (TZ), a cupulate cavity that ends at the opposite end of TG. In the "Gran Dolina" filling we have found five levels with micromammals numbered from base to summit TD-3, TD-4, TD-5, TD-6 and TD-1. In the "Tres Simas complex" we have found the following levels with micromammals : in the "North entrance of Tres Simas"[4] the levels TN-4, TN-5 and TN-6, in the "Galeria" or "Sala Intermedia" the level TG-11 and in the "Cueva de los Zarpazos" the level TZ-4.

The small mammals (orders Insectivora, Chiroptera, Rodentia and Lagomorpha) are the more abundant faunal group in all the fillings of Atapuerca. In this paper we conduct a preliminary study of the Insectivores, Rodents and Lagomorphs of Atapuerca with special attention to the Rodents. Among the rodents, the Arvicolidae generally have a higher ratio of fossil remains (teeth) and are also the more diversified group in all the localities of Atapuerca. The nomenclature used for the morphological study of the Arvicolidae teeth is the one used by Van Der Meulen (1973). The measurements are the greatest length (L) and width (W) of the occlusal side of the teeth in mm. We express the range of variation of the length and width and the mean value.

(3) From 1984 to now one of us (E.G.) has been under contract to the Project.
(4) In the next chapters we use the name "Tres Simas" instead of "North entrance of Tres Simas" for short.

SYSTEMATIC DESCRIPTION

Small mammals from "Trinchera"

Order INSECTIVORA BODWICH, 1821

Description and discussion

The Insectivorous are present in all the localities of Atapuerca. There are three families represented : Erinaceidae, Soricidae and Talpidae. There is, at least, *Erinaceus* cf. *europaeus* L., 1758 in the localities TN-4 and TN-5, *Sorex* sp. in TG-11 and TZ-4, and *Talpa europaea* L., 1758 in TD-3, TD-5 and TG-11.

Order RODENTIA BODWICH, 1821

Family SCIURIDAE GRAY, 1821

Marmota marmota (Linneo, 1758)

Localities

TD-6 and TN-4.

Description and discussion

The marmot is very scarce in Atapuerca. There are only two teeth in all whose size and morphology are that of the species.

Family GLIRIDAE THOMAS, 1897

Eliomys quercinus Linneo, 1766

Localities

TD-3, TD-5, TD-6 (middle and upper), TN-4, TN-6 (upper) and TZ-4.

Description and discussion

Although the dormouse is not very abundant (16 teeth), it is present in several localities of Atapuerca. The teeth are of similar size and morphology to those of the recent species *E. Quercinus*.

Family HYSTRICIDAE BURNETT, 1830

Hystrix cf. *vinogradovi* Argyropulo, 1941

Localities

TG-11 and TZ-4.

Description and discussion

There is a porcupine of small size similar to the species *H. vinogradovi* in several localities of Atapuerca although it is not very abundant (3 teeth).

Family CRICETIDAE MURRAY, 1866

Allocricetus bursae Schaub, 1930

Localities

TD-3, TD-4, TD-5, TD-6 (lower, middle and upper), TD-11, TN-4, TN-5, TN-6 (lower and upper), TG-11 and TZ-4.

Description and discussion

This species of hamster fossil is present in all the localities of Atapuerca in which it is generally quite abundant (275 teeth). The size and the morphology of the different populations of Atapuerca are similar. So we can not distinguish subspecies as Chaline (1972) did in different French localities of the Middle Pleistocene.

Family ARVICOLIDAE GRAY, 1821

Mimomys savini Hinton, 1910

Localities
TD-5 and TD-6 (middle and upper)

Mimomys sp.

Localities
TD-3, TD-4 and TD-6 (lower)

Description and discussion
These populations of *Mimomys* have the hypsodont teeth with roots, cement and great size. It is present in all the fossiliferous levels of "Gran Dolina" except in the uppermost one (TD-11). The existence of some M_1 (13) in the localities TD-5 and TD-6 (middle and upper) with the size (length between 3,08 and 3,65 mm.) and the characteristic morphology of *M. savini* (see plate I, fig. 9) allow us to attribute these populations to this species.

Pliomys episcopalis Mehely, 1914

Localities
TD-3, TD-4, TD-5 and TD-6 (lower and middle)

Pliomys lenki (Heller, 1930)

Localities
TD-11, TN-4, TN-6 (lower and upper), TG-11 and TZ-4.

Pliomys sp.

Localities
TD-6 (upper).

Description and discussion
The molars of these populations have the characteristic morphology of *Pliomys* with roots and without cement. The differences between these species are in the distinct morphology of the anteroconid complex of the M_1 of which there are 41 specimens in these populations. In *Pliomys episcopalis* there is a T6 in the AC but there is not a real T7 : The AC3, with its rounded front end, has LSA5 hardly outlined and without LRA5. In *Pliomys lenki,* nevertheless, there are two confluent triangles (T6 and T7) because of the remarkable development of the LSA5 and LRA5 which built the fourth lingual triangle (T7). As for the size, the length of the M_1 of *Pliomys episcopalis* (between 2,60 and 2,90 mm.) is smaller than that of *Pliomys lenki* (between 2,84 and 3,40 mm.).

Pitymys gregaloides Hinton, 1923

Locality
TD-3.

Description and discussion
The M_1 of this population (6 specimens) has the three first enamel triangles closed, the T4 and T5 are confluent. We find two morphotypes of the AG2 according to those defined by Van Der Meulen (1973) : the "hintonid" and the "gregalid" which is the most abundant (see plate I, fig. 1). The size of the M_1, which varies between 2,36 and 2,76 mm., and its morphology, are similar to those of *Pitymys gregaloides* of the localities of the lower part of the Middle Pleistocene of Villany 6 and 8 and Nagyharsanyhegy 4 (Van Der Meulen, 1973).

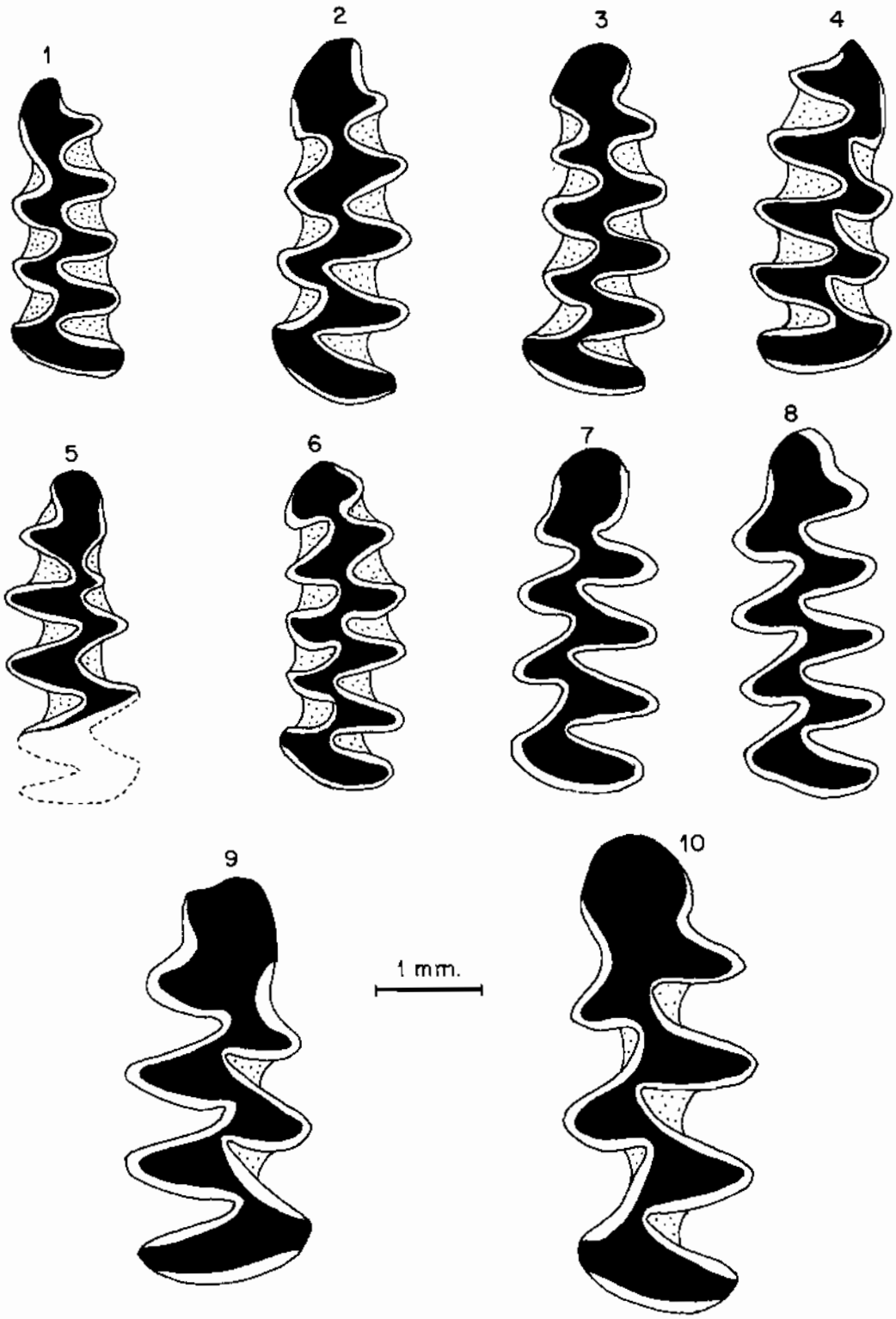

Plate I - Pitymys gregaloides *Hinton, 1923 : fig. 1 : M1 izq. (TD-3/11) ;*
Pitymys gregaloides-arvalidens *Hinton, 1923 - Kretzoi, 1958 : fig. 2 : M1 izq. (TD-5/240) ;*
Pitymys subterraneus *(Selys-Longchamps, 1826) : fig. 3 : M1 izq. (TD-11/26) ;*
Microtus brecciensis *Giebel, 1847 : fig. 4 : M1 der. (TN-6/92) ;*
Microtus arvalis-agrestis *(Pallas, 1778) - Linneo, 1798 : fig. 5 : M1 der. (TG-11/74) ; fig. 6 : M1 izq. (TN-4/70) ;*
Pliomys episcopalis *Mehely, 1914 : fig. 7 : M1 izq. (TD-5/536) ;*
Pliomys lenki *(Heller, 1930) : fig. 8 : M1 izq. (TN-4/122) ;*
Mimomys savini *Hinton, 1910 : fig. 9 : M1 der. (TD-5/497) ;*
Arvicola *sp. : fig. 10 : M1 izq. (TN-4/65).*

Pitymys gregaloides-arvalidens Hinton, 1923 - Kretzoi, 1958

Localities

TD-4, TD-5 and TD-6 (lower, middle and upper).

Description and discussion

The M_1 of these populations (275 specimens) has the three first enamel triangles closed ; the T4 and T5 may be completely confluent and in front of each another, or may be alternating and not so widely confluent. Concerning the variation of the AC2 we can distinguish in these populations three morphotypes according to those of Van Der Meulen (1973) : the "hintonid", the "gregalid" and the "arvalid" which is the most frequent. The size of these populations (the length of the M_1 varies between 2,30 and 3,03 mm.) and the morphology are similar to those of *Pitymys gregaloides* and *Pitymys arvalidens* of the localities of the lower part of the Middle Pleistocene of Villany 6 and Nagyharsanyhegy 4 (Van Der Meulen, 1973).

Pitymys subterraneus (Selys-Longchamps, 1826)

Localities

TD-11, TN-4, TN-5, TN-6 (lower and upper), TG-11 and TZ-4.

Description and discussion

The morphology of the molars of these populations is similar to that of *Pitymys subterraneus* of the Middle and Upper Pleistocene. The M_1 (199 specimens) present the three first enamel triangles closed, the T4 and T5 are confluent, the T6 and T7 are smaller than the others. The morphology of the AC2 corresponds to the morphotype "arvalid" according to Van Der Meulen (1973). The length of the M_1 varies between 2,32 and 3,08 mm.

Microtus brecciensis Giebel, 1847

Localities

TD-3, TD-5, TD-6 (lower, midle and upper), and TN-6 (lower).

Description ans discussion

These populations of Atapuerca present the characteristic morphology of *Microtus brecciensis* of the Middle Pleistocene : The M_1 (24 specimens) have five closed enamel triangles, and they present the AC2 of two different morphotypes according to those defined by Van Der Meulen (1973) : the "arvalid" type with LRA4 and BRA3 in opposition, and the "nivalid" type with LRA4 and BSA4 alternating. The LSA5 and BSA4 are remarkable ; LRA5 also is present and BRA4 may be hardly outlined or may be highly developped building a sixth triangle. The length of the M_1, between 2,26 and 2,90, is small compared to the populations of the species of Saint-Steve-Janson and Orgnac 3 (Chaline, 1972), Cueva del Agua (Lopez Martinez & Ruiz Bustos, 1977) and Cullar-Baza (Ruiz Bustos & Michaux, 1976).

Microtus arvalis-agrestis (Pallas, 1778) - Linneo, 1798

Localities

TD-11, TN-4, TN-5, TN-6 (lower and upper), TG-11 and TZ-4.

Description and discussion

The morphology of the M_1 of these populations (77 specimens), with five or six closed enamel triangles, LRA5 deep, and generally T6 and T7 confluent and alternating, is similar to that of *Microtus arvalis* and *Microtus agrestis* of the Middle and Upper Pleistocene and present day. The length of the M_1, between 2,20 and 3,05, is also similar.

Arvicola chalinei (Alcalde, Agusti & Villalta, 1981)

Localities
TD-5 and TD-6 (middle)

Description and discussion
This small species of *Arvicola* presents a very constant morphology. The M_1 (5 specimens) have no roots, are hypsodont and have cement. In occlusal view, the M_1 is composed of a posterior lobe, three closed enamel triangles, T4 and T5 largely confluent and separated by a wide neck from the anteroconid complex. This morphology corresponds to the morphotype "arvicolid" of those of the AC2 of the M_1 according to Van Der Meulen (1973). The morphology and size of this population (the length of the M_1 varies between 2,56 and 2,88 mm.) are similar to those of the species *Arvicola chalinei* that was originally described in Cueva Victoria and included in the genus *Allophaiomys* (Alcalde *et al.*, 1981). Nevertheless, we agree with Ruiz Bustos & Sesé (1985) who include this species in the genus *Arvicola* because its morphology is very similar to that of *Arvicola* and its size is next to that of the small species *Arvicola mosbachensis* Schmindtgen, 1911.

Arvicola sp.

Localities
TD-11, TN-4, TN-5, TN-6 (upper), TG-11 and TZ-4.

Description and discussion
The morphology of the M_1 of these populations (17 specimens) is characteristic of *Arvicola* : hypsodont, without roots, with little cement, with three closed enamel triangles, and the anteroconid complex built by two confluent triangles in the AC3. The large size of these populations (the length of the M_1 varies between 3,60 and 4,60 mm.) approaches that of *Arvicola sapidus* Miller 1908, of the localities of Nestier (Chaline, 1972), Cueva del Agua (Lopez Martinez & Ruiz Bustos, 1977) and Aridos (Lopez Martinez, 1980). But in the molars of Atapuerca there is no differenciation of the enamel, while in those cited populations the enamel of the lower molars is thicker in the posterior than in the anterior part of the triangles (Lopez Martinez, 1980).

Family MURIDAE GRAY, 1821

Apodemus sp.

Localities
TD-3, TD-5, TD-6 (middle and upper), TD-11, TN-4, TN-5, TN-6 (lower and upper) and TZ-4.

Description and discussion
This is the only Muridae found in Atapuerca. It is difficult to differenciate species of *Apodemus* on the basis of the few teeth that have been found in the localities of Atapuerca because some species can only be separated by the percentage of the presence of some characters of the upper and lower M2 according to Pasquier (1974).

Order LAGOMORPHA BRANDT, 1855

Family LEPORIDAE GRAY, 1821

Description and discussion
The presence of *Oryctolagus* in the localities TD-11 and TG-11 of Atapuerca is a certainty because of the existence of some P_3 with the characteristic size and morphology of the genus. In other localities of Atapuerca there are some teeth and bones of lagomorphs of for which taxonomic determination can not be made for want of diagnostic pieces.

Small mammals from "sima de los huesos"

In the filling known as "Sima de los Huesos" anteneandertalian human remains were found (Aguirre et al., 1976 ; Aguirre & de Lumley, 1977). In this filling a preliminary sample has provided the following fauna :

Order INSECTIVORA BODWICH, 1821

Insectivora indet.

Order CHIROPTERA BLUMENBACH, 1779

Chiroptera indet.

Order RODENTIA BODWICH, 1821

Family CRICETIDAE MURRAY, 1866

Allocricetus bursae Schaub, 1930

Family ARVICOLIDAE GRAY, 1821

Microtus/Pitymys sp.

Family MURIDAE GRAY, 1821

Apodemus sp.

CONCLUSIONS

The small mammals faunas from the several localities of Atapuerca may be correlated with those of other Middle Pleistocene European localities.

We may distinguish in the "Trinchera of Atapuerca" the two following faunal associations, taking into mainly account the Arvicolidae, biostratigraphically the most interesting group :

— The lower stratigraphic levels of "Gran Dolina" (TD-3, TD-4, TD-5 and TD-6) are characterised by the following species : *Pitymys gregaloides-arvalidens, Microtus brecciensis* primitive, *Pliomys espiscopalis, Mimomys savini* and *Arvicola chalinei*. This faunal association is similar to those of the European localities of Villany 6 and 8 and Nagyharsanyhegy 4 (Van Der Meulen, 1973), Süssenborn (Fejfar, 1969) and Westbury 2 and 3 (Bishop, 1982), although the species of *Microtus* are different and *Arvicola chalinei* is not present in those European localities. These faunas can be dated in the Biharian, phases Nagyharsanyhegy/Templomhegy, that are later than the faunas with *Allophaiomys* of the lower Biharian (Beftia phase). Van Der Meulen (1973) places the Hungarian localities in the *Pitymys arvalidens* zone.

— The higher level of "Gran Dolina" (TD-11) and all the localities of "Tres Simas" (TN-4, TN-5, TN-6), "Galeria" (TG-11) and "Cueva de los Zarpazos" (TZ-4) are characterised by the following species : *Pitymys subterraneus, Microtus arvalis-agrestis, Pliomys lenki* and *Arvicola* sp. of large size. Primitive *Microtus brecciensis* is also present in the topmost level of "Tres Simas" (TN-6). All these species are present in the Middle Pleistocene since the last phases of the Biharian (Vertesszöllös/Uppony) and during the Oldenburgian. The small size of *Microtus brecciensis* of Atapuerca compared to the populations of the localities of Cúllar-Baza (Ruiz Bustos & Michaux, 1976), Aridos (Lopez Martinez, 1980) and Cueva del Agua (Lopez Martinez & Ruiz Bustos, 1977) in Spain, and with those of Saint-Steve-Janson and Orgnac 3 in France (Chaline, 1972), indicates that *Microtus brecciensis* of Atapuerca, is very primitive. Therefore, this second faunal group from Atapuerca may cover a lapse of time between the last phases of the Biharian and the lower Oldenburgian.

In almost all the localities of "Trinchera" we have found the hamster *Allocricetus bursae* and the dormouse *Eliomys quercinus* that are very common in the Middle Pleistocene localities. More rare but very interesting is the presence of *Marmota marmota* in some levels of "Gran Dolina" and "Tres Simas". The presence of marmota in the lower levels of "Gran Dolina" is the oldest recorded in Europe. Another interesting discovery is the small porcupine *Hystrix* cf. *vinogradovi* in "Galeria" and "Cueva de los Zarpazos" that is also the oldest record of *Hystrix* in Spain during the Pleistocene.

As for the micro fauna of "Sima de los Huesos" of Atapuerca, unfortunately the fossil material is so scarce to date that it can not be correlated with those from the karstic fillings of "Trinchera" and other localities.

In summary, the lower levels of "Gran Dolina" contain the oldest faunas of Atapuerca, and the upper level of "Gran Dolina" that contain the more recent faunas, all dated to the Middle Pleistocene may be correlated with those from the "Tres Simas complex". Thus in Atapuerca there exist faunal sequences of small mammals which age extends from the beginning of the Middle Pleistocene (phases Nagyharsanyhegy/Templomhegy of the Biharian) to the last phases of the Biharian (Versteszöllös/Uppony) or probably the lower Oldenburgian.

The majority of the small mammals recovered in Atapuerca are typical of a temperate climate, like the other Middle Pleistocene faunas in Spain (Lopez Martinze & Ruiz Bustos, 1976 ; Lopez Martinez, 1980). The exception is the presence, in some localities of the I and II faunal groups of Atapuerca of *Marmota marmota,* considered a rodent typical of cold and continental climates. However *Hystrix,* present in some localities of the I and II faunal groups, is an indicator of warm climate.

As for the paleoecological interpretation, on one hand exist open-country species like the hamster *(Allocricetus bursae)* and some species of *Microtus Pitymys* in almost all the localities of Atapuerca. On the other hand, in Atapuerca there are also wood land species like the dormouse *(Eliomys quercinus)* and, according to Van Der Meulen (1973), *Pliomys* which is regarded as a forest dwelling species. We may therefore evoke a picture of a predominantly open landscape with some wooded areas, perhaps not very different from the present landscape of Atapuerca.

BIBLIOGRAPHY

AGUIRRE E., BASABE J.M. y TORRES T. (1976) - Los fósiles humanos de Atapuerca (Burgos) : Nota preliminar. *Zephyrus,* 26/27 : 489-511.

AGUIRRE E. & LUMLEY M.A. de (1977) - Fossil Men from Atapuerca, Spain : Their bearing on Human evolution in the Middle Pleistocene. *Journal of Human Evolution,* 6 : 681-688.

ALCALDE G., AGUSTI J. y VILLALTA J.F. de (1981) - Un nuevo *Allophaiomys* (Arvicolidae, Rodentia, Mammalia) en el Pleistoceno inferior del Sur de España. *Acta Geol. Hispanica,* 16, 4 : 203-205.

BISHOP M.J. (1982) - The mammal fauna of the early Middle Pleistocene cavern infill site of Westbury-sub-Mendip somerset. *Special papers in Paleontology,* 28 : 1-108, London.

CHALINE J. (1972) - Les Rongeurs du Pléistocène Moyen et Supérieur de France. Systématique, Biostratigraphie, Paléoclimatologie. *Cahiers de Paléontologie,* CNRS ; 1-410.

FEJFAR O. (1969) - Die Nager aus den Kiesen von Süssenborn bei Weimar. *Paläont. Abh. A.*, 3, 3/4 : 761-770.

LOPEZ MARTINEZ N. (1980) - Los micromamiferos (Rodentia, Insectivora, Lagomorpha y Chiroptera) del sitio de ocupación achelense de Aridos-I (Arganda, Madrid). *Ocupaciones achelenses en el Valle del Jarama, Publ. Excma. Dip. Prov. Madrid* : 161-202.

LOPEZ MARTINEZ N. y RUIZ BUSTOS A. (1977) - Descubrimiento de dos yacimientos del Pleistoceno medio en el kars de la Sierra Alfaguara (Granada). Síntesis estratigráfica de este periodo en la región Bética. *Estudios Geol.*, 33 : 255-265.

MEULEN A.J. van der (1973) - Middle Pleistocene smaller mammals from the Monte Peglia (Orvieto, Italy) with special reference to the phylogeny of *Microtus* (Arvicolidae, Rodentia). *Quaternaria*, 17 : 1-144.

PASQUIER L. (1974) - *Dynamique évolutive d'un sous-genre de Muridae, Apodemus (Sylvaemus). Étude biométrique des caractères dentaires de populations fossiles et actuelles d'Europe Occidentale.* Thèse 3ème cycle. Univ. Montpellier : 1-168.

RUIZ BUSTOS A. et MICHAUX J. (1976) - Le site préhistorique nouveau de Cullar de Baza-I (Province de Grenade, Espagne) d'âge pléistocène moyen. Étude préliminaire et analyse de la faune des Rongeurs. *Géologie Méditerranéenne*, 3, 3 : 173-182.

RUIZ BUSTOS A. y SESÉ C. (1985) - Evolución de los géneros *Mimomys, Arvicola* y *Allophaiomys* (Arvicolidae, Rodentia, Mammalia) en el Plioceno y Pleistoceno de la Península Ibérica. *Estudios geol.*, 41 : 99-104.

TORRES PEREZ HIDALGO T. de (1978) - Los osos fósiles de la Sierra de Atapuerca (Burgos-España). *Boletín Geológico y Minero*, LXXXIX-II : 123-132.

ZAZO C., GOY J.L. y HOYOS M. (1983) - Estudio geomorfológico de los alrededores de la Sierra de Atapuerca (Burgos). *Estudios geol.*, 39 : 179-185.

| SPECIES | LOCALITIES | | |